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Effect of Milk Fat Content and Boiling Temperature on Consistency and pH of Yogurt Produced

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Abstract-

Yogurt is the most widely used fermented product worldwide. It has great health benefit as it is served as a probiotic worldwide. The quality of yogurt produced is dependent on different variables such as type of milk, type of started culture, conditions during processing such as temperature and time of incubation. In this experiment, we tested effect of milk fat content and boiling temperature of milk on consistency and pH of yogurt produced when kept at room temperature for 6 days. It was expected that low fat milk will produce highly consistent yogurt however the expectations were not met because high fat milk gave good results. On the other hand, high boiling temperature of milk was expected to give better consistency and pH on production and results were same as expected in this case.

Keywords: Yogurt, pH, milkfat, temperature

Yogurt is the most important dairy product used in everyday life. It is the oldest known fermentation product consumed around the world. It is produced when Lactobacillus bacteria convert milk into thick whitish product with high consistency. It is highly consumed fermented product due to its health benefits. It also acts as probiotic food [1]. During yogurt production, many steps are involved, and all these steps play important role in the good production of yogurt. The quality of yogurt depends on raw milk, processing conditions, and starter culture however the quality of yogurt produced is affected by incubation temperature and time. With an increase in temperature, the consistency of yogurt increases with a decrease in pH value because the standard pH of milk is 6.7 and that of yogurt is around 4.5 much less than the pH of the milk. A study by Ibrahim proved that temperature affects density, consistency, and pH. The value of viscosity, consistency increases with an increase in temperature and pH start decreasing. Another experiment was performed by Medeiros *et.al.* which gave the effect of different kinds of milk on yogurt production.[3]. Yogurt industry also create many empowerment options for women in rural areas across many parts of the world. Many women in rural areas produce yogurt at home with their traditional methods for home use as well as secondary income for household. The dairy industry-based farming system contributes more income to the household income of the farmers as compared to solo farming system [4].

This report deals with the idea of change in milk fat content and boiling temperature of milk and significant effect of change on yogurt production. Consistency and pH were checked

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as results. Several trials were taken while experimenting to observe the change for both the variables and results were taken on calculated days. The experiment has following purposes-

- To determine effect of milk fat content on consistency and pH of yogurt under suitable conditions.
- To determine effect of boiling temperature on consistency and pH of yogurt produced.

The hypothesis states

Consistency of yogurt produced with low fat milk is higher than high fat milk and higher boiling temperature increases consistency and lower pH than milk boiled at low temperature. pH plays an important role to confirm the quality of yogurt produced. Since the standard pH of yogurt is calculated to be around 4.0-4.4 and that of milk is around 6.7-6.8. Milk is basic in nature according to the pH whereas yogurt is acidic. During yogurt production, milk will start acidifying and pH will start dropping continuously. On the other hand, yogurt is thick highly viscous product whereas milk is free flowing liquid. Consistency of milk is changed when yogurt is produced but production of yogurt is also affected by concentration of milk, thus two different milk fat contents were tested during this experiment to confirm the hypothesis stated which say low milk fat content will give better consistency of yogurt than high fat milk. Moreover, during yogurt production milk is boiled to a specific temperature before inoculation to give optimum temperature for bacteria for fermentation. Thus, boiling temperature also plays a vital role in good yogurt production. Confirmation of hypothesis was done using two different temperatures for milk to boil to approve if high boiling temperature gives better consistency or not.

Scope

Production of yogurt is however very easy process, but every single step is equally important from taking milk to boiling it at suitable temperature for better fermentation to keeping it in a place where ideal conditions are achieved. If there is a slight error in any of this process, the yogurt produced will not be as good as required. There are two bacteria involved in this process- *Lactobacillus Bulgaricus* and *Streptococcus thermophilus*, however some other organisms are also present in yogurt. There are known as good bacteria [2]. Every bacterium grows under optimum temperature, because of this before inoculation the milk should be cooled down to 45°C approximate in order not to kill bacteria inoculated. The method used was referred from experiment conducted by Ibrahim [1,3]. Both papers explained the variable taken by us in this experiment in which Milk fat content was our first independent variable and Boiling temperature of milk was second. The dependent variables were consistency of yogurt produced and the pH.

Materials and Methods

1. **Milk-** Skim milk and ~4 milk was taken from No frills superstore and was fresh during both the trials.
2. **Yogurt-** Yogurt inoculum used was plain yogurt. Half spoon of yogurt was inoculated in each case.
3. **pH meter-** Digital pH meter of Panacea brand was taken from Canadian tire to check pH for results.
4. **Thermometer-** Digital thermometer of brand Master chef was bought from Canadian tire.

5. **Stove-** Household stove was used to boil the milk before inoculation.
6. **Containers-** Plastic containers of equal volume were taken to store the yogurt for 6 days.
7. **Measuring container-** A 500ml measuring container was used to measure the milk however 200ml of milk was taken each time.

Method

1. **Preparation of milk-** For milk fat content, 200ml of skim milk and ~4% milk was taken separately in two different heat resistant pans using measuring container and heated up to 85°C. It was then cooled down to 45°C for inoculation.

For boiling temperature variable, 200ml ~4% milk was taken in two different pans to boil at 72°C for one and maximum temperature for another respectively and was cooled down to 45°C before inoculation. Digital thermometer was used to check all the temperatures.

2. **Negative control-** For negative control, skim milk was taken was such after cooling down to 45°C for milk fat content. For boiling temperature, 72°C milk was taken as such.
3. **Positive control-** For 1st independent variable, milk fat content, ~4% milk was inoculated with plain yogurt and kept in container labelled positive control. For second variable, boiling temperature, milk boiled at maximum temperature was inoculated with plain yogurt and kept at room temperature in container labelled positive control.
4. **Inoculation-** Both containers for milk fat content were inoculated with half spoon of plain yogurt and kept at room temperature for 6 days. Similarly, both containers for boiling temperature were also inoculated with plain yogurt and kept at room temperature for 6 days.
5. **Computation of results-** Results were taken on 7th day of the experiment using digital pH meter. To evaluate consistency, organoleptic measurement was done.

Results and Discussion

Results were taken as quantitative and qualitative control. For quantitative control, we have calculated the pH of the yogurt with the help of pH meter of different fat milk and different boiling temperature. On the other

hand, we observed the colour of yogurt and consistency for the qualitative control.

QUANTITATIVE CONTROL

Table-1- This table represents average results of pH for Yogurt produced with different milk fat contents of Trial-1 and Trial-2 after incubation at room temperature for 6 days.

pH of yogurt produced	pH of trial 1 average	pH of trial 2 average
Controls- Positive	4.6	4.5
Negative	7.1	7.3
0% milk	7.5	7.2
4% milk	6	4.5

Table2- This table depicts the average results of pH of different boiling temperatures of Trial-1 and Trial-2 after incubation at room temperature for 6 days.

pH of yogurt produced	pH of trial 1 average	pH of trial 2 average
Controls- Positive	4.6	4.4
Negative	6.7	6.7
72ºC boiling temperature	6.7	7.2
Maximum boiling temperature	6.0	4.3

QUALITATIVE VARIABLES / CONTROLS

Color and consistency of different milk fat contents yogurt

Table3- This table represents average consistency results of Yogurt produced with two different milk fat contents of Trial-1 and Trial 2 after incubation at room temperature after 6 days.

Colour and viscosity of yogurt produced	Trial 1 average results	Trial 2 average results

0% fat milk	No consistency, very low consistent, low viscosity ,Heterogeneous, change in colour from white to off white due to long storage period.	Not consistent, Heterogeneous, colour change to pale cream colour.
4% fat milk	High consistency, higher viscosity, homogenous, change in colour due to long period of storage.	High consistency, homogenous, change in colour due to storage.
Controls Negative	No change	No change
Control Positive	High consistency, homogenous, change in colour due to storage.	High consistency, homogenous, change in colour due to storage.

Colour and consistency of different boiling temperature yogurt

Table 4- This table depicts average consistency and colour results of different boiling temperatures of Trial-1 and Trial-2 after incubation at room temperature for 6 days.

Colour and viscosity of yogurt produced	Trial 1 average results	Trial 2 average results
72ºC boiling temperature	No consistency, very low consistent, low viscosity, Heterogeneous, change in colour from white to off white due to long storage period.	Not consistent, Heterogeneous, colour change to pale cream colour.
98ºC or maximum temperature	High consistency, higher viscosity, homogenous, change in colour due to long period of storage.	High consistency, homogenous, change in colour due to storage.
Controls Negative	No change	No change
Control Positive	High consistency, homogenous, change in colour due to storage.	High consistency, homogenous, change in colour due to storage.

Discussion

According to the research, the study revealed that as the temperature increases, the consistency of the yogurt start increasing whereas, the pH value start decreasing and on other side, high fat milk produced more consistent yogurt rather than the low-fat milk [1]. In our experiment, we found that the less fat milk produced less consistency and more basicity in pH and higher boiled temperature milk produced more consistency with less pH. The table 1 revealed pH produced from different fat milk content of both trials average in which it was clearly seen that more basicity was observed in the yogurt production with 0% fat milk in both trials and the average was 7.5 and 7.2 while acidic pH was observed in the yogurt production with high fat milk (~4%) that was calculated averagely 6 and 4.5 for both trials. In negative controls, there were also more basicity was observed in both trials and high acidic pH was observed in positive controls for both trials that was 4.6 and 4.5 respectively.

Similarly, the table 2 represents the average pH produced from different boiling temperature milk yogurt in which it was apparent clear that with the boiling temperature variable, pH decreases when milk was boiled at maximum temperature was observed 6.0 and 4.3 for both trials respectively, whereas more pH was observed under 72º C boiling temperature that was averagely recorded 6.7 and 7.2 respectively. So, it means higher boiling temperature milk produced more consistent yogurt with less pH.

Moving further, the table 3 depicts the qualitative results for different milk fat content yogurt produced from which it was transparent that yogurt produced from high fat milk (~4%) was more consistent than the low-fat milk content and also color changes from white to pale color due to long storage period, whereas, in controls, positive control produced consistent yogurt as negative control remain same.

Similarly, the table 4 represents the qualitative results for different boiling temperature milk yogurt production which revealed that yogurt produced from higher boiling temperature was more consistent than the lower boiling temperature (72ºC) in both trials. Moreover, in controls, positive control showed more consistency and negative control remains same and colour changes from white to off white due to long storage time for 6 days.

Conclusion

Our hypothesis statement of fat milk content contradicts as the results from the experiment revealed that the consistency produced from high fat milk was higher than low fat milk and the pH is more basic which proves the hypothesis statement wrong for fat milk variable. Secondly,

the hypothesis statement for boiling temperature proved right as the result from the experiment revealed that the consistency produced from maximum boiling temperature milk was higher than the lower boiling temperature and the pH decreases when the temperature increases and hence it was proved in the experiment. So, this experiment proved that high fat milk content produced more consistency yogurt and high boiling temperature produces more consistency in yogurt and pH decreases [1].

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